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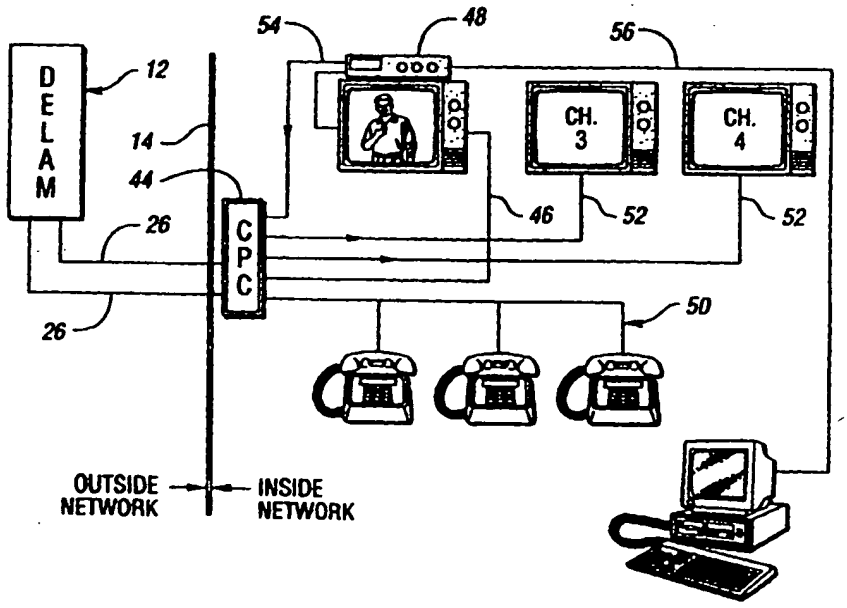
(54) Title: WIRING ARCHITECTURE FOR PROVIDING COMBINED VOICE AND VDSL SERVICE TO RESIDENTIAL BUILDINGS

(57) Abstract

An inside wiring architecture is provided having a central service connection center or central point of connection (44) located within a residential building (14) to support FTTC or FTTN distribution of combined VDSL video, voice, and data services to residential buildings. A system for communicating combined video, voice and data signals to and from residential buildings incorporates the inside wiring architecture. A network processing terminal (12) is located within a predetermined distance from a residential building (14) and arranged to process the voice, video and data signals to and from a central office (16). The cental service connection center (44) is arranged to send and receive voice signals over at least a first twisted copper pair cable (50) connected to a telephone terminal, digital video and data signals over a second twisted copper pair cable (46) connected to a STB located within the building, and analog video signals over a coaxial cable connection (46) to a television terminal. The STB is arranged to distribute the digital video to the television terminal and the data signals to a computer terminal. An aerial drop feed in the form of a twisted pair of copper wires (26) is used to connect the network processing terminal (12) to the central service connection center (44) to reduce the generation of noise and extend the range of the VDSL signals.



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WIRING ARCHITECTURE FOR PROVIDING COMBINED VOICE AND VDSL SERVICE TO RESIDENTIAL BUILDINGS

TECHNICAL FIELD

The present invention relates to wiring arrangements for distributing voice, video, and data signals to residential dwellings, and more specifically to an improved wiring and drop feed arrangement suitable for distributing Very-high-data-rate Digital Subscriber Line (VDSL) type signals to residential dwellings.

BACKGROUND ART

Traditional inside wiring schemes available in today's residential dwellings are not capable of supporting high speed data services or digital quality video. More specifically, traditional home wiring schemes are inadequate for a "fiber to the curb" (FTTC) architecture, which requires all cable runs to be "homerun" from a central point of connection (CPC) or central service connection center (CSCC) to the connected device, and the use of CAT 5 twisted copper pair and RG6 coaxial cable. In addition, coax cable amplifiers are not acceptable this type of architecture, and coaxial cable runs from a network interface device (NID) to a set-top box (STB) are limited to 150 feet. Other limitations imposed in an FTTC architecture specify that telephony CAT 5 should be split no more than five times because of telephony ringing generator limit, and that primary coax feed can only be split up to eight times due to unacceptable levels of signal loss. When implementing such an architecture, each connected device (STB, data device, etc.) counts as a split off the coaxial supply.

Another source of inadequacy of traditional wiring schemes involves the use of an aerial flat copper drop feed used to provide a connection to residential buildings. An example of such a drop feed is shown in cross-section in Figure 6, and includes two copper conductors 300 and 302 extending in parallel within an outer insulative sheath 304. The problem with such a drop feed arrangement results from the parallel conductors inherently acting as an antenna structure which transmits noise outwardly therefrom to the surrounding environment, as well as receives and mixes noise with the signals being delivered on the feed. Because such feeds are both externally and internally noisy, signal quality is compromised. As a result, the reach of a VDSL formatted service is significantly reduced.

Therefore, a need exists for a wiring architecture which is capable of supporting distribution of combined voice, high speed data, and digital video services to residential dwellings in a cost-effective manner without sacrificing signal quality or reach.

DISCLOSURE OF INVENTION

It is therefore an object of the present invention to provide an inside wiring architecture capable of supporting distribution of combined video, voice, and data services to residential buildings.

It is another object of the present invention to provide an inside wiring architecture which utilizes a central service connection center (CSCC or CPC) to support FTTC or "fiber-to-the-node" (FTTN) distribution of combined VDSL video, voice, and data services to residential buildings.

It is yet another object of the present invention to provide an improved aerial drop feed arrangement which reduces noise and therefore extends the distribution range of combined voice, video and data signals transmitted in a VDSL type format.

In accordance with these and objects of the present invention, a system is provided for communicating combined video, voice and data signals to and from residential buildings having a central office connected to a public switched telephone network and a multi-media video and data service provider, the central office including a host digital terminal for combining and separating voice, video and data signals for transmission and receipt on a fiber optic distribution line. A network processing terminal is located within a predetermined distance from a residential building and arranged to process the voice, video and data signals. An inside wiring architecture includes a central service connection center (CSCC or CPC) located within the residential building for processing the combined voice, video and data signals to send and receive voice signals over at least a first twisted copper pair cable connected to a telephone terminal, digital video and data signals over a second twisted copper pair cable connected to a STB gateway located within the building, and providing analog video signals over a coaxial cable connected to a television terminal. The STB is arranged to distribute the digital video to the television terminal and the data signals to a computer terminal. An aerial drop feed connects the network processing terminal to the central service connection center.

In accordance with one aspect of the present invention, the video and data signals are communicated in a VDSL format, and the aerial drop feed is

implemented as a twisted pair of copper wires to reduce the generation of impulse noise. In addition, the central service connection center includes a housing having a plurality of CAT 5 type line jacks, and a plurality of coaxial cable jacks mounted thereon, and at least one coaxial splitter and CAT 5 type splitter mounted within the housing and connected to the plurality of CAT 5 type line jacks and coaxial jacks. The central service connection center housing is arranged to provide space for one or more Ethernet hubs and routers, home management systems, utility metering system, and home alarm systems, and dimensioned to fit within a stud cavity of a wall in the building.

The above objects and other objects, features, and advantages of the present invention are readily apparent from the following detailed description of the best mode for carrying out the invention when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIGURE 1 is a block diagram of a combined voice, video, and data distribution system for multi-dwelling residential locations in accordance with the present invention;

FIGURE 2 is a block diagram of an inside wiring arrangement for a multi-dwelling residential location in accordance with the present invention;

FIGURE 3 is a block diagram of a combined voice, video, and data distribution system for single occupancy residential locations in accordance with a second embodiment of the present invention;

FIGURE 4 is a block diagram of an inside wiring arrangement for a single occupancy residential location in accordance with a first embodiment of the present invention;

FIGURE 5 is a diagram of a twisted copper pair aerial drop feed in accordance with the present invention; and

FIGURE 6 is a cross-section of a prior art flat aerial drop feed.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to Figure 1, a combined voice, video, and data distribution system 10 using VDSL technology is shown for providing such services to multi-dwelling residential locations in accordance with the present invention. More specifically, a DSL access multiplexer (DSLAM) 12 is located external to a physical building 14 and connected to a central distribution office 16 via a fiber optic cable 18. The DSLAM is preferably located within 4,000 feet (≈1220 m) of a central point of connection (CPC) service center panel (shown and described below in connection with Figure 2) located within each building. This allows the distribution fiber to be moved closer to the customers situated in multi-dwelling unit buildings. DSLAM 12 is arranged to operate as a single platform for voice, video, and data signals.

Central office 16 includes a class 5 digital switch 20 for coupling of telephony traffic such as DS-1 service to and from fiber optic cable 18 by way of a broadband digital terminal 22. The central office further includes appropriate encoder/decoder circuitry and a multiplexer arrangement 24 for supporting transmission of VDSL formatted signals on cable 18.

In a preferred embodiment, DSLAM 12 is arranged to provide 26 Mbit/s downstream (towards the customer), and 3 Mbit/s upstream (away from the customer), where downstream and upstream are supplied on a single twisted pair (CAT 5/POTS) copper wire cable 26. As described in more detail below, the twisted pair cable carries the combined voice, data, and video signals to the CPC for redistribution over individual distribution terminals located within the building. The CPC is arranged to separate the voice, data and video signals into output signals for use with customer television set-top boxes, telephones and personal computers.

The central office receives digital/analog video programming and data signals from a multi-media type service provider 28. Service provider 28 includes system elements such as a real-time MPEG encoder 30 connected to a sateliite antenna system 32 and a radio antenna system 34, and a data server 36 connected to a data router 38. The encoder and router are connected to an asynchronous transfer mode (ATM) switch 40 and multiplexer 42 for transmitting and receiving video and data signals on the fiber optic line. Overall operation of such a service provider is known to those skilled in the art and does not form a part of the present invention.

Figure 2 illustrates an inside wiring architecture for a multi-dwelling residential building in accordance with the present invention. As shown, all DSLAMs are preferably located on the edge of a property line. The twisted pair feed 26 is connected to a central point of connection (CPC) service center panel 44 arranged to support individual "homerun" wiring from each outlet in each dwelling sub-unit. The home run wiring is provided by coupling a first CAT 5 twisted pair cable 46 to a STB 48, a second CAT 5 50 twisted pair cable to individual telephone units, and at least one coaxial cable 52 to each television unit for distribution of analog video and signaling information. A coaxial cable 54 is connected to the STB 48 for processing of signaling information to be sent to the central office. A CAT 5 line 56 is used to connect gateway 48 to any personal computers via an Ethernet type connection.

In this embodiment, the coaxial cable must be 75 ohm impedance RG6 CATV rated cable having a maximum run length 150 ft. (≈ 45.7 m) when used as a home run from a 1 x 8 splitter to the individual outlets. At least two universal outlets, e.g., two RG6 coax cables and one RJ45 jack (for 10 Base T Ethernet connections), are provided for each building, with termination covers being placed on all unused RG6 jacks.

With respect to the inside wiring architecture of the present invention, coaxial splitters with less than 4dB loss per split can be used, with a maximum of eight split-offs allowed on a coaxial cable run. STB 48 is arranged to support video signals and Ethernet capability. The DSLAM is arranged to support

POTS, ISDN-PRI & BRI, Coin, Special Services, and T1 connections. The DSLAM utilizes an ATM backbone to transport video and data signals.

Figure 3 provides a block diagram illustrating a distribution system 100 using a FTTC technology to provide combined video, data, and telephony signals to single occupancy residential locations in accordance with the present invention. The multi-media service center 28 and the central office 16 are identical to that described above in connection with Figure 1. In this embodiment, an optical network unit (ONU) 102 is used to feed single occupancy type residences. ONU 102 allows the fiber to be moved closer to the building, e.g., a maximum distance of 75 ft. (≈ 22.9 m). This technology also combines voice, data, and video onto a single platform, and provides high speed data access to the Internet, corporate networks, intranets, intraoffice-employee to employee, video-conference capabilities and video channels with video on demand. The voice and data signals are fed over a coaxial drop feed 104, while the telephony signals are carried over a twisted pair copper wire feed 106.

Figure 4 illustrates an inside single occupancy dwelling wiring architecture in accordance with the embodiment of Figure 3. ONU 102 is preferably arranged to provide 52 Mbit/s downstream (toward the customer), and 6 Mbit/s upstream (away from the customer), where downstream and upstream are supplied a single twisted pair (CAT 5) cable 106. The twisted pair feed is preferably implemented as at least a three pair twisted copper drop. ONU 102 receives power from a twisted copper wire connection to a remote power supply (RPS) 108.

Coaxial feed 104 and twisted pair feed 106 are connected to a network interface device (NID) 110 and a central point of connection (CPC) 112 arranged to support individual "homerun" wiring from each outlet in the residence. The home run wiring is provided by coupling a first CAT 5 twisted pair cable 114 to a STB 116 for distribution of digital video and data signals, a second CAT 5 118 twisted pair cable to individual telephone units, and at least one coaxial cable 120 to each television unit for distribution of analog video and signaling information. A coaxial cable 122 is connected to the STB 116 for processing of signaling information to be sent to the central office, and a CAT 5 line 124 is used to connect STB 48 to any personal computers via an Ethernet type connection. As with system 10, the coaxial cable must be 75 ohm impedance RG6 CATV rated cable. At least two universal outlets, e.g., two RG6 coax cables and one RJ45 jack (for 10 Base T Ethernet connections), are provided for each building, with termination covers being placed on all unused RG6 jacks.

STB 116 is arranged to support video signals and Ethernet capability. The ONU is arranged to support POTS, ISDN-PRI & BRI, Coin, Special Services, and T1 connections. The ONU also utilizes an ATM backbone to transport video and data.

The splitter used to divide the coaxial signal must be a 75 ohm impedance CATV grade splitter. In addition, the following specifications define the operating characteristics of the splitter: a return loss of 16 dB @ 10 to 50 MHz; isolation of 20 dB @ 10 to 50 MHz; insertion loss of 3.8 dB @ 10 to 50 MHz (2 -

way, 3 - way low loss ports); 7.6 dB @ 10 to 50 MHz (4 - way, 3 - way high loss port); and 11.4 dB @ 10 to 50 MHz (8 - way).

With respect to the CPC for both embodiments, all residential buildings are provided with such a distribution hub. All "homerun" wiring terminates in CPC. The CPC includes appropriate coaxial splitters and CAT 5 splitters. In addition, the CPC is preferably arranged to provide space for data devices such as Ethernet hubs and routers, home management systems, utility metering systems, and alarm systems. The CPC can be located near an AC power outlet, and is preferably dimensioned to mounted within a conventional 16" stud cavity of a wall in the building structure.

As described above, all aerial drop feeds to residential buildings are implemented using a twisted copper wire pair as represented in Figure 5. More specifically, a first and second copper wire 200 and 202 are twisted about each other and cover by an insulating sheath 204. In accordance with the present invention, the use of a twisted pair aerial drop feed reduces external generation of noise as well as input of noise onto signals being carried by the drop feed because the twisting of the wires effectively cancels out signals, thereby nullifying any transmitting/receiving antenna characteristics of the drop feed.

Thus, with the above described embodiments, the present invention effectively combines voice, data, and video signals onto a single platform. This in-turn allows the system of the present invention to provide improved support for high speed data access to the Internet, corporate networks, intranets, and intraoffice-

employee to employee video-conferencing capabilities, as well as video channels with video on demand. Combining the voice, data and video services into a single delivery system allows more efficient transport of all a customer's telecommunications needs.

While embodiments of the invention have been illustrated and described, it is not intended that these embodiments illustrate and describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and that various changes may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A system for communicating combined video, voice and data signals to and from residential buildings comprising:

a central office connected to a public switched telephone network and a multi-media video and data service provider, the central office including a host digital terminal for combining and separating voice, video and data signals for transmission and receipt on a fiber optic distribution line;

a network processing terminal located within a predetermined distance from a residential building and arranged to process voice, video and data signals;

an inside wiring architecture comprising a central service connection center located within the residential building arranged to send and receive voice signals over at least a first twisted copper pair cable connected to a telephone terminal, digital video and data signals over a second twisted copper pair cable connected to a set-top box (STB) located within the building, and analog video signals over a coaxial cable connected to a television terminal, wherein the STB is arranged to distribute the digital video to the television terminal and the data signals to a computer terminal; and

an aerial drop feed connecting the network processing terminal to the central service connection center.

2. The system of claim 1 wherein the video and data signals are communicated in a VDSL format.

3. The system of claim 2 wherein the aerial drop feed comprises a twisted pair of copper wires.

4. The system of claim 1 wherein central service connection center comprises a housing having a plurality of CAT 5 type line jacks, and a plurality of coaxial cable jacks mounted thereon, and at least one coaxial splitter and CAT 5 type splitter mounted within the housing and connected to the plurality of CAT 5 type line jacks and coaxial jacks.

5. The system of claim 4 herein the central service connection center housing is arranged to provide space for one or more Ethernet hubs and routers, home management systems, utility metering systems, and home alarm systems.

6. The system of claim 4 wherein the central service connection center housing is dimensioned to fit within a stud cavity of a wall in the building.

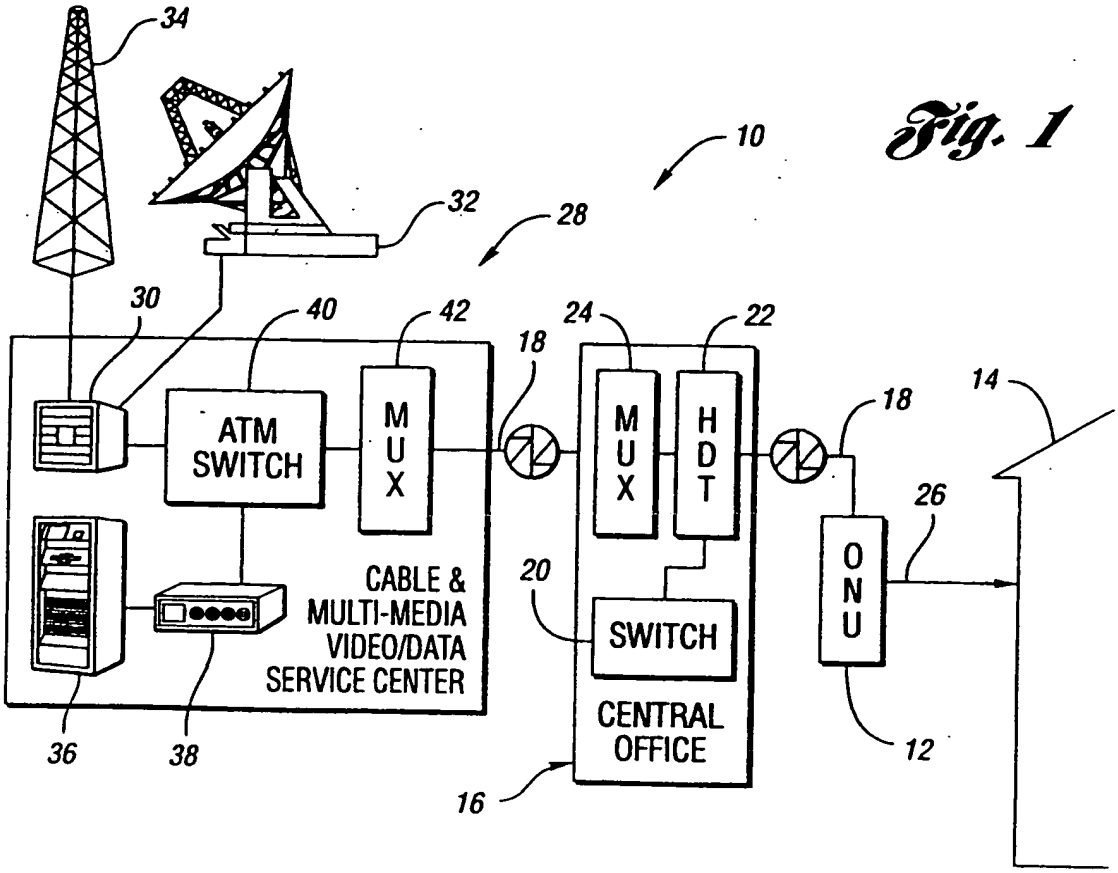
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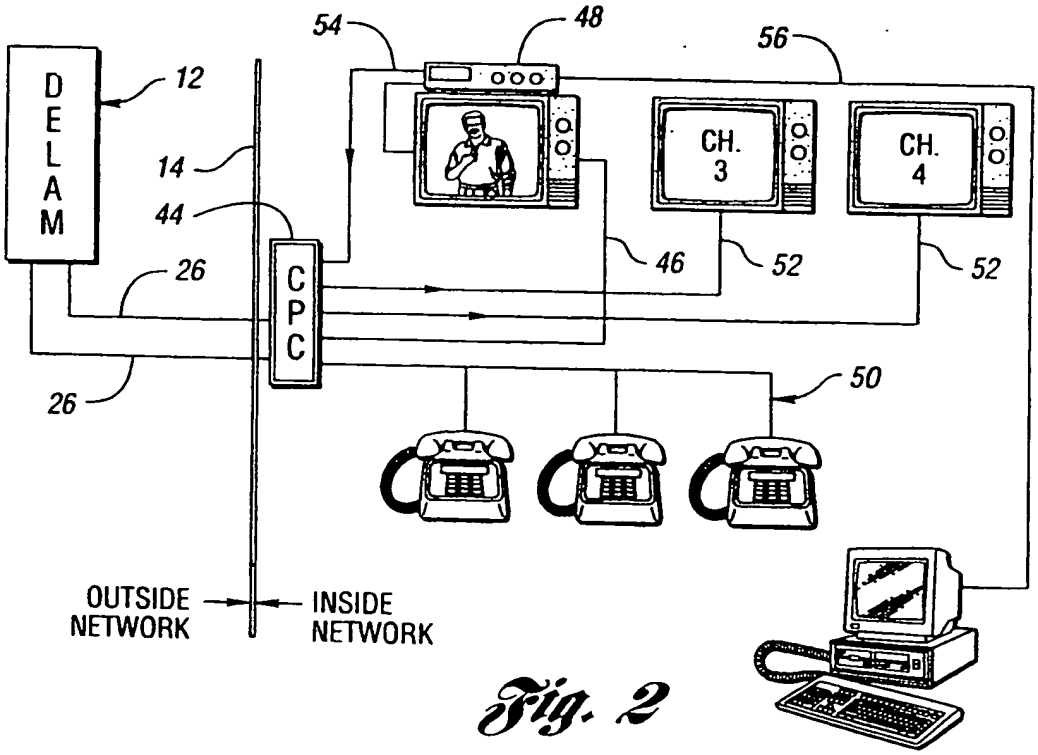
Fig. 1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OUTSIDE NETWORK
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Fig. 2

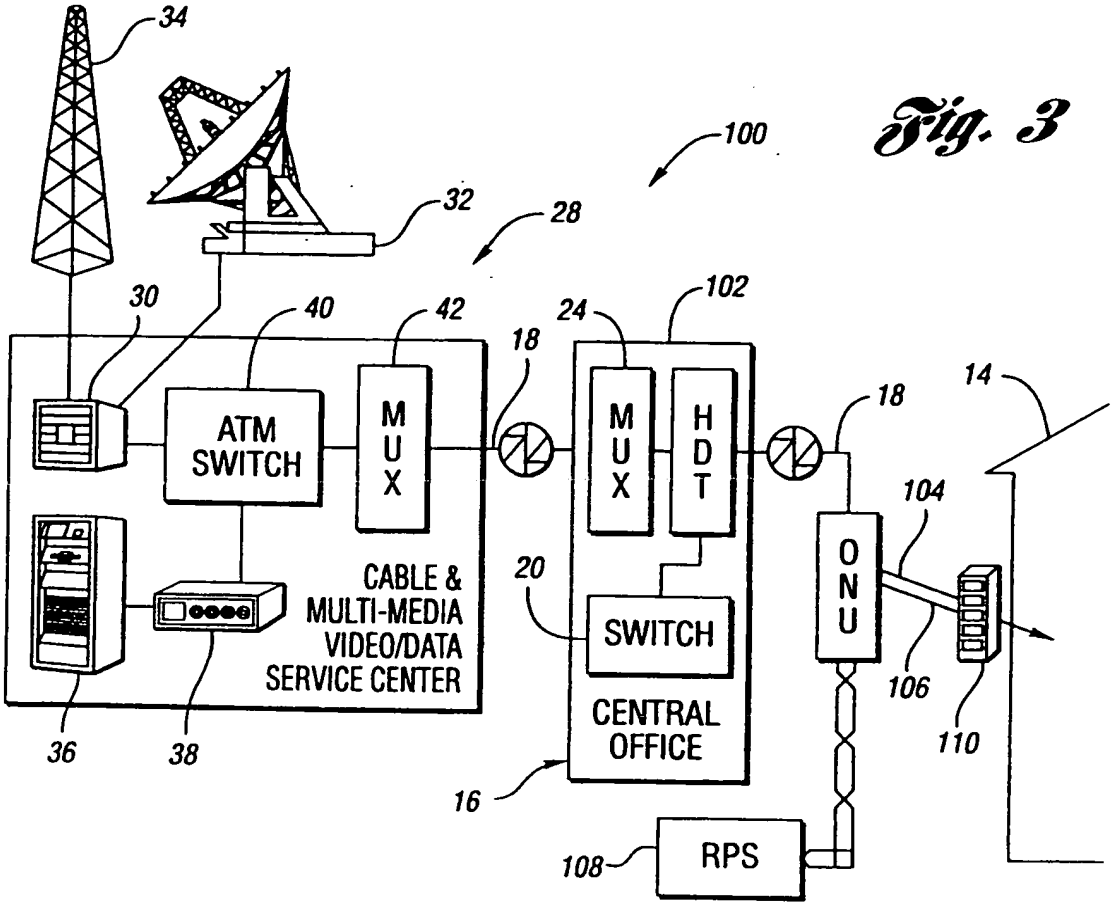
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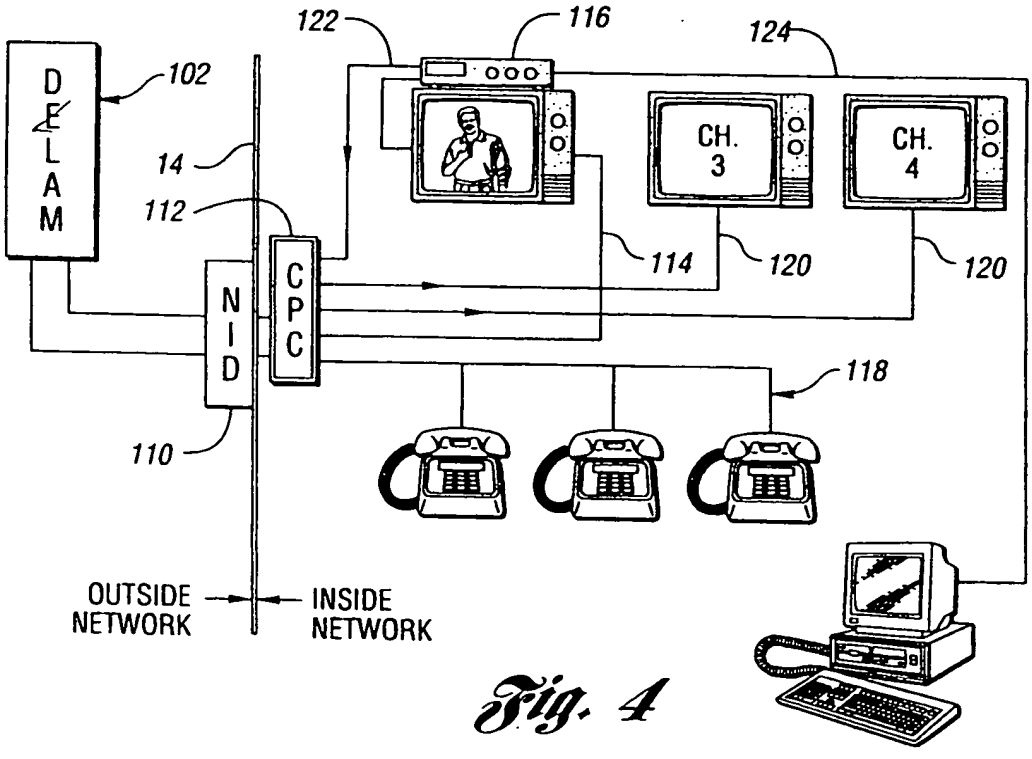
Fig. 3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OUTSIDE NETWORK
INSIDE NETWORK

Fig. 4

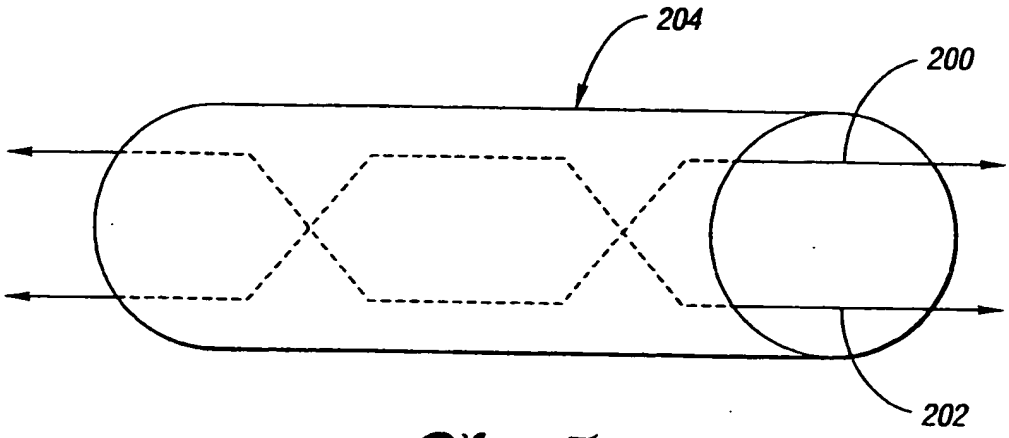

Fig. 5

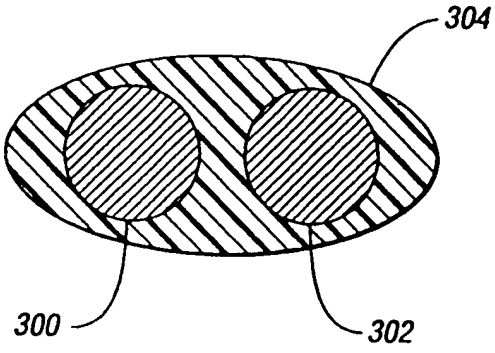

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/30475

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H04H 1/00; H04N 7/10
US CL :455/3.1; 348/8

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/3.1, 4.1, 4.2, 5.1, 6.1, 6.2, 6.3; 348/6, 8, 10, 12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,594,789 A (SEAZHOLTZ et al) 14 January 1997, see whole document.	1-6
Y	US 5,793,413 A (HYLTON et al) 11 August 1998, see whole document.	1-6
Y	US 5,842,111 A (BYERS) 24 November 1998, see whole document.	1-6

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